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The physico-chemical parameter status of Lonar crater Lake, India

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ABSTRACT

Lonar Crater (19°58'N and 76°31'E) Lake is the third largest natural salt-water lake in the world. Lonar Crater is a wet land which is important biodiversity sector. The lake brine supports typical microbial flora and fauna which need to be investigated to access its value of wet-land to be recognized as Ramsar Site of India. During the study period fourteen different physico-chemical parameters were studied: temperature, P^H, Total Dissolved Solid, Electrical conductivity, Dissolved oxygen, Free CO_2, carbonates and bicarbonates, hardness, chlorides, salinity, calcium and magnesium hardness. The crater physical setup, its relative geographical and ecological isolation has evolved limnological status in a unique way. Its unusual and climatic isolation highlights the ecosystem as an ecological wonder. Present work deals with analysis of physico chemical parameters that aim to investigate the pollution level to know eutrophication status of Lonar Crater Lake. The study of hydrological status reveals variation of salinity during rainy season and summer while the lake is leading towards eutrophication.

KEY WORDS: LONAR LAKE, PHYSICO-CHEMICAL PARAMETERS.

INTRODUCTION

Lonar Crater Lake is believed to have originated due to meteoritic impact and is the third biggest lake in the world. Lonar crater is only such great basaltic province of India. The remarkable shape, size and uniqueness of crater lake at crater basin being saline has attracted the attention of geologist, ecologists, archaeologists, naturalists and astronomists and has been the subject of several studies on various aspects of crater

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ecosystem. This inland lake with no effluent is fed by a seasonal drainage mainly confined to its periphery and also by number of fresh water springs. The crater contains many sub-ecosystems, each constituting a subtle combination of floral and faunal species, due to localized variations in the conditions of soil, water and humidity. The Lonar ecosystem has evolved in a unique way due to the unusual geohydrological and climatic conditions. However, the same conditions have made it extremely fragile and vulnerable to human interventions. Therefore, the biotic zones resulting from such isolation need immediate protection (Malu, 2002; Kodarkar, 2008; Pedge *et al*., 2013).

The Lonar crater has attracted the attention of world geologists for investigation of its origin and the source of salinity of lake water; it is ecological wonder (Malu *et al*., 2007). The positive correlation has indicated that the abundance of *B. plicatilis* has significantly positive correlation with temperature as there was an increase in all chemical parameters such as water temperature, pH, TS, TDS, Cl, Salinity and EC in the Lonar lake water (Pedge *et al*., 2013).

The time of excavation of material from the crater may last for several minutes following the impact, while the amount of impact melt produced is dependent on the abundance of water in the target rocks (Melosh, 1989). Target material below the excavation depth is pushed downwards, whereas the strata above this depth may be pushed upwards (dePater and Lissauer, 2001) as seen in the Lonar crater. Lonar Crater Lake consist of various eco-tones inhabited a wide range of plant and animals life.

The cultural eutrophication of this lake has taken place due to the untreated domestic sewage and garbage coming out from Lonar town that reaches into the lake. Inside the crater, some farmers downing farming and hence the use of inorganic fertilizers, insecticides and pesticides like toxic compounds inters in lake. Simultaneously, Hygienic activities are carried out by the local people in the fresh water springs and used waste water enters in lake at last (Yannawar *et al*., 2013).

The lake water was observed to be blue green in colour due to dominance of algal blooms. The water sample emanated strong murky odour. The algal bloom in Lonar Lake water is responsible for absorption of light and heat from sunlight due to its coloured pigments leading to higher temperature of lake water. The Lonar Lake water appears to be saline due to high concentration of dissolved solids and total suspended solids (Verma and Chaudhari, 2013). Lonar Meteorite Lake appear to be a unique aquatic ecosystem characterized by hypersaline, hyper alkaline, poor range in DO but all physico-chemical parameters in this region was beyond the permissible limit in different season only according to WHO and ISI standards. The correlation coefficient indicates significant positive and negative correlation of parameters with each other. The positive correlation means one parameter increase with other parameters also increase (Pedge and Ahirrao, 2013).

SITE DESCRIPTION:

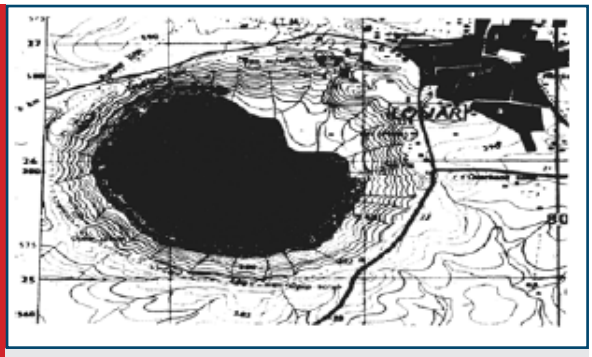

FIGURE 1: Topographic map of Lonar Crater (19°58'N and 76°31'E).

Lonar Crater (19°58'N and 76°31'E) Lake is a unique meteoritic crater in basaltic rock. It lies in a nearly circular depression surrounding on all sides by steeply rising escarpments. The lake basin is closed on all sides and therefore has no outlet. The lake brine is known for its high salinity and alkalinity, micro-ecosystem, a wide range of plant and animal life. The saline lake, marshy areas around it, freshwater streams, natural and man-made plantations, crop fields and the remnants of the original forest and scrub referred to above, all provide special niches for plants and animals. Lonar Lake has a localized temperature system as it is being subterranean hollow closed from all sides; the lake basin is partly screened from direct sun light at different places and at different times of the day (Dabhade, 2006).

MATERIAL AND METHODS

Four sampling station selected For the Present work these are S1, S2, S3, and S4 East, south, west and north. Monthly Water sample were collected from four different sampling sites in the period of one year (Jul 2013 to Jun 2014). Water Temperature analyzed by simple thermometer, TDS analyzed by the EC-TDS ANALYSER CM 183 ELICO, EC analyzed by Conductivity meter CM-180 ELICO, Total Hardness, Free CO_2, Carbonates, Bicarbonates, Chloride, Salinity, Calcium, Calcium Hardness, and Magnesium Hardness analyzed by Titrometric method with the help of APHA (2006) standard method for water analysis.

TABLE 1: Physico-chemical parameters of Lonar Crater.

Parameter	Site	Month											
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Temp (C°)	S1	25	21	23	29	27	26	25	22	25	26	27	28
	S2	26	21	23	30	27	26	26	23	25	27	27	30
	S3	26	21	24	31	28	28	26	24	26	28	28	30
	S4	27	21	24	32	29	28	26	25	26	28	29	31
Ph	S1	10	10	10	10	10	10	10	10	10	10	10	10
	S2	10	10	10	10	10	10	10	10	10	10	10	10
	S3	10	10	10	10	10	10	10	10	10	10	10	10
	S4	10	10	10	10	10	10	10	10	10	10	10	10
TDS ppt	S1	7.2	7	6.8	6	5.9	6.1	5.5	5.7	6.1	7.4	8.1	8.5
	S2	7.2	6.8	6.4	5.8	5.6	5.4	5.6	6.1	6.8	7.3	8	8.5
	S3	7.4	6.8	7	7.3	7.5	6.3	6.9	6	5.7	7.4	8.1	8.5
	S4	7.6	7.1	6.4	5.2	6.2	5.7	7.2	5.9	7.2	7.4	8.1	8.5
EC ms	S1	12.1	14.2	11.8	10	12.3	11.6	12.4	12.	13.6	8.2	17.0	17.4
	S2	12.2	12.4	14.4	16.2	14.2	12.7	13.6	11.7	14.8	7.9	16.0	16.0
	S3	14.7	14.2	14.3	14.4	12.1	12.4	12.4	11.5	16.2	7.9	16.1	16
	S4	16.2	14.1	12.6	13.7	11.8	12	11.6	11.4	14.3	10.5	16.1	16.1
DO mg/L	S1	7.2	8.5	8	8.2	7.1	8	6.8	5	9.4	0.6	3.2	6.3
	S2	7.3	8	8	1.3	6.2	3.3	5.6	5	7.3	0.8	6.5	7.6
	S3	7.8	6	6	1.3	2.6	7.3	3.2	5	9.7	0.6	2	7.1
	S4	8	11	9	3.6	4.2	7	3.8	7.2	16.5	0.3	2	12.2
Free CO_2 mg/L	S1	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS
	S2	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS
	S3	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS
	S4	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS	ABS
CO_3 mg/L	S1	524	540	584	612	524	440	480	640	786	1120	1780	1710
	S2	552	523	528	494	570	480	518	650	810	1074	2050	1100
	S3	504	522	572	688	486	356	442	652	770	1560	2664	1766
	S4	560	562	600	526	454	340	466	598	776	1420	2750	2160
HCO_3 mg/L	S1	760	826	810	832	1020	1168	1360	2170	1360	8	1000	756
	S2	728	840	840	842	940	1024	1126	2224	1536	10	1180	850
	S3	800	846	836	856	926	920	956	1528	1440	36	1390	1072
	S4	826	800	850	820	842	826	906	1980	1640	34	1210	1100
Total Hardness mg/L	S1	68	60	60	142	108	110	116	36	70	80	178	88
	S2	66	72	64	100	56	32	64	86	76	82	94	92
	S3	72	63	68	90	64	40	72	114	74	80	104	76
	S4	76	60	80	90	68	40	72	120	74	84	96	66
Chloride mg/L	S1	460	4821	4538	3545	3686	3545	3977	5672	4062	4466	5105	4495
	S2	510	4963	4112	3686	3843	3828	4169	4112	2984	4069	6269	5274
	S3	496	5246	4110	3303	4133	4183	4403	3779	4551	4126	5162	5282
	S4	482	5104	3970	3545	4006	3970	4424	3857	3899	4041	4148	4892

	Salinity mg/L	S1	8318	8702	8190	6505	6765	6398	7299	10408	7332	8062	9214	8114
		S2	9214	8958	7422	6765	7052	6910	7650	7545	5387	7345	11316	9521
		S3	8958	9470	7960	6062	7585	7550	8079	6934	8215	7448	9317	9534
		S4	8702	9214	7166	6505	7351	7166	8118	7077	7038	7294	7487	8830
	Calcium mg/L	S1	36.2	29.4	35.4	31.1	35.4	38.7	32	67.3	32	25.3	39.6	35.4
		S2	31.14	24.4	31.14	23.7	32	64.8	52.1	101	32.82	23.56	36.2	21.9
		S3	32.82	23.56	38.7	24.4	30.3	38.7	38	50.5	29.45	24.4	37.9	22.72
		S4	23.56	30.3	29.5	27	27	43.7	24.4	90	35.4	21.9	35.4	16
	Calcium Hardness mg/L	S1	9.03	7.35	8.82	7.77	8.8	9.66	7.98	16.8	7.98	6.3	9.87	8.82
		S2	7.77	6.09	7.77	5.88	7.98	16.17	13.0	25.2	8.19	5.88	9.03	5.46
		S3	8.19	5.88	9.66	6.09	7.56	9.66	9.45	12.6	7.35	6.09	9.45	5.67
		S4	5.88	7.56	7.35	6.72	6.72	10.92	6.09	22.47	8.82	5.46	8.82	3.99
	Mg. Hardness mg/L	S1	14.38	12.8	12.5	32.7	24.1	24.48	26.3	4.68	15.13	17.98	41.0	19.31
		S2	14.2	16.08	13.7	23	11.7	3.86	12.4	14.83	16.54	18.57	20.7	21.11
		S3	15.57	13.93	14.2	20.4	13.7	7.4	15.2	24.74	16.26	18.03	23.1	17.16
		S4	17.11	12.79	17.7	20.3	14.9	7.09	16	23.79	15.9	19.16	21.3	15.13

RESULTS AND DISCUSSION

The most important physical parameter temperature of four sampling sites (Table No.1) was measured during the study period minimum temperature ranges from 21C° and maximum to 32C°. At sampling site S1 minimum temperature 21C° and maximum was 29C°. During July to October it was 21C° to 29C°. Temperature was gradually increases during this season. In sampling site S2 Minimum 21C° and Maximum 30C0. At Sampling Site S3 minimum temperature was recorded 21C° and Maximum was 31C°. At sampling site S4 minimum temperature was 21C° and maximum 32C°. Slight fluctuation was there due to changing time of sampling (Fig No.2).

During the study period Ph of four sampling site was recorded 10 which is alkaline. The pH values of the lake water are generally higher than 10 and occasionally reaching 12 (Shinde and More, 2013) TDS (Total Dissolved Solid) during the study period Minimum TDS was found to 5.2 ppt. and Maximum was 8.5 ppt. At sampling site S1 minimum was 5.5 ppt. and maximum was 8.5 ppt. At sampling site S2 minimum was 5.8 ppt. and maximum was 8.5 ppt. At Sampling Site S3 minimum TDS was recorded 5.7 ppt. and Maximum was 8.5 ppt. At sampling site S4 minimum TDS was 5.2 ppt. and maximum 8.5 ppt. during the month of July to October it was decreases while in month of March to Jun it was increases (Fig No. 6). TDS is in the range of 6.4 mg/L to 15.2 mg/L studied by Pawar, (2010).

Electrical conductivity during study period minimum was found to be 7.9 ms and maximum was 17.06 ms Highest values were recorded in the month of May and June. (Fig No. 8). DO (Dissolved oxygen) during study period minimum was 0.3 mg/L and maximum was 12.2 mg/L little fluctuation was observed due to time of sampling. In sampling site S1 minimum DO was 0.6 mg/L and maximum was 9.4 mg/L. At sampling site S2 minimum was 0.8 mg/L and maximum was 8.0 mg/L. At S3 minimum was 0.6 mg/L and maximum was 9.7 mg/L. in sampling site S4 minimum DO was 0.3 mg/L and maximum was 12.2 mg/L. (Fig No. 3).

Free CO_2 was absent in four sampling site during the study period. CO_3 (Carbonates) Due to absent of free CO_2 that may be converted in to carbonates or Bicarbonates along the four sampling site minimum carbonates was 340 mg/L and maximum was 2750 mg/L. In sampling site S1 the minimum $C0_3$ was 44o mg/L and maximum was 1780 mg/ L. At site S2 minimum was 480 mg/L and Maximum was 2050 mg/L. at sampling site S3 minimum was 356 mg/L and maximum was 2664 mg/L. At site S4 minimum was 340 mg/L and Maximum was 2750 mg/L. During the month of July to Jun Carbonates was increases. Highest value observed in month of Jun and lowest was observed in July (Fig No. 5).

HCO_3 (Bicarbonates) during the study periods minimum value of Bicarbonates was 8 mg/L and maximum was 2224 mg/L. In sampling site S1 minimum was 8 mg/L and maximum was 2170 mg/L. at sapling site S2 minimum was 10 mg/L and maximum was 2224 mg/L. Bicarbonates value was increases from month of July to February and little fluctuation in month of April and then it can again increases from month of Jun. At sampling site S3 the minimum value was 36 mg/L and

maximum was 1528 mg/L. In sampling site S4 minimum value of Bicarbonates was 34 mg/L and maximum was 1980 mg/L. In all four sampling site values are fluctuated due to the time of sampling (Fig No. 6).

Total Hardness in four sampling site in the study periods was 32 mg/L to 178 mg/L. At sampling site S1 minimum value of Hardness was 36 mg/L and maximum was 178 mg/L. At S2 it was 32 mg/L and maximum was 100 mg/L. At S3 minimum was 40 mg/L and maximum was 114 mg/L. at S4 minimum was 40 mg/L and maximum was 120 mg/L. (Fig No. 4). During the study period minimum chloride was 2984 mg/L and maximum was 6269 mg/L. At sampling site S1 minimum was 3545 mg/L and maximum was 5672 mg/L. In sampling site S2 minimum was 2984 mg/L and maximum was 6269 mg/L. At S3 minimum was 3303 mg/L and maximum was 5282 mg/L. in sapling site S4 minimum was 3545 mg/L and maximum was 5104 mg/L. (Fig No. 9). Permissible value of chloride is 250 mg/l, Gaikwad and Sasane, (2013) also found about 3248.9 mg/l, which is above the maximum permissible level of 1000mg/l. High chloride waters may also produce a laxative effect.

Lonar crater is well known about their alkalinity and salinity. During this study periods the minimum value of salinity was 5387 mg/L and maximum was 11316 mg/L. At sampling site S1 minimum salinity was 6398 mg/L and maximum was 10408 mg/L. At sampling site S2 minimum was 5387 mg/L and maximum was 11316 mg/L. At S3 minimum was 6062 mg/L and maximum was 9534 mg/L. In sampling site S4 minimum value was 6505 mg/L and maximum was 9214 mg/L. (Fig No. 10). Borul, (2012) was recorded salinity from 8460 mg/L to 10250 mg/L. Calcium During study periods lowest value of Calcium was 15.99 mg/L and highest was 101 mg/L. In sapling site S1 minimum value of calcium was 25.25 mg/L. and maximum was 67.33 mg/L. At sampling site S2 minimum value of calcium was found to be 21.88 mg/L and maximum was 101 mg/L. At S3 minimum was 22.72 mg/L and maximum was 50.5 mg/L. At sampling site S4 minimum was 15.99 mg/L and maximum was 90 mg/L. Highest calcium value is recorded in month of February and Lowest was in month of Jun. (Fig No. 11). Calcium Hardness During the study periods minimum value of calcium Hardness was 3.99 mg/L and maximum was 25.2 mg/L. At sampling site S1 minimum value of calcium hardness was 6.3 mg/L and maximum value was 16.8 mg/L. At sampling site S2 minimum was 5.46 mg/L and maximum was 25.2 mg/L. At S3 minimum was 5.88 mg/L and maximum was 12.6 mg/L. At sampling site S4 minimum value of calcium hardness was 5.46 mg/L and maximum was 10.92 mg/L. Highest value recorded in month of February (Fig No. 12).

Magnesium Hardness During the study periods minimum value of magnesium was 3.86 mg/L and maximum was 41.2 mg/L. at sampling site S1 minimum value of Mg. hardness was 4.68 mg/L. and maximum was 41.2 mg/L. At sampling site S2 minimum was 3.86 mg/L and maximum was 21.11 mg/L. At sampling site S3 minimum value was 7.4 mg/L and maximum value was 24.74 mg/L. at sampling site S4 minimum value was 7.09 mg/L and maximum was 23.79 mg/L. (Fig No. 13).

GRAPHICAL REPRESENTATION OF PHYSICO-CHEMICAL PARAMETERS

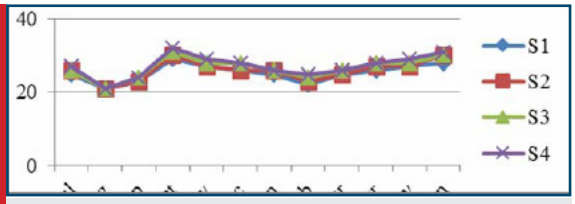

FIGURE 2: Physical Parameters - Temperature (C°) at sampling site (S1, S2, S3, S4), 2013-14.

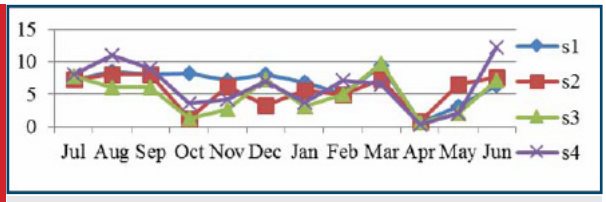

FIGURE 3: Physicochemical Parameters- DO (mg/L) at sampling site (S1, S2, S3, S4), 2013-14.

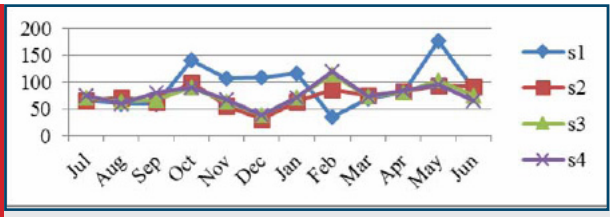

FIGURE 4: Physicochemical Parameters- Hardness (Mg/L) at sampling site (S1, S2, S3, S4), 2013-14.

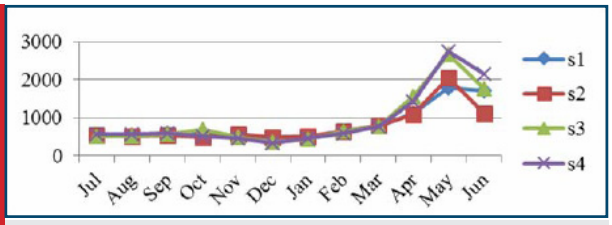

FIGURE 5: Physicochemical Parameters- Carbonates (mg/L) at sampling site (S1, S2, S3, S4), 2013-14.

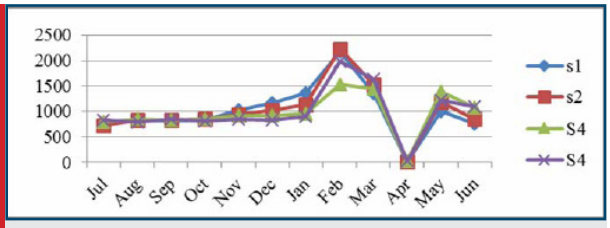

FIGURE 6: Physicochemical Parameters Bicarbonates (mg/L) at sampling site (S1, S2, S3, S4), 2013-14.

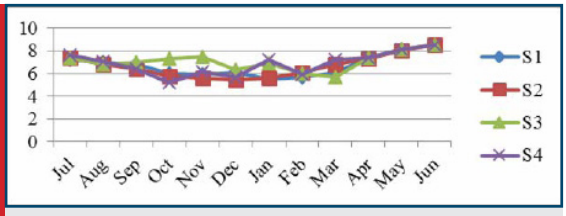

FIGURE 7: Physicochemical Parameters- TDS (mg/L) at sampling site (S1, S2, S3, S4), 2013-14.

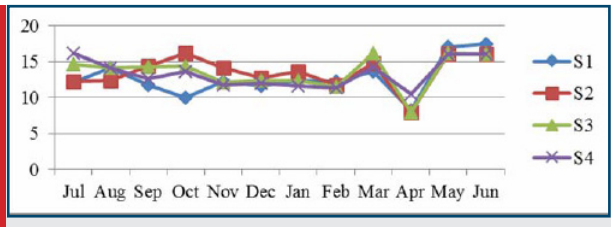

FIGURE 8: Physicochemical Parameters- EC (mS) at sampling site (S1, S2, S3, S4), 2013-14.

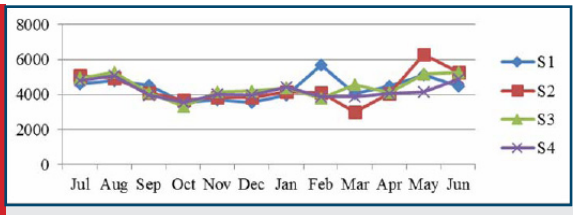

FIGURE 9: Physicochemical Parameters- Chloride (mg/L) at sampling site (S1, S2, S3, S4), 2013-14.

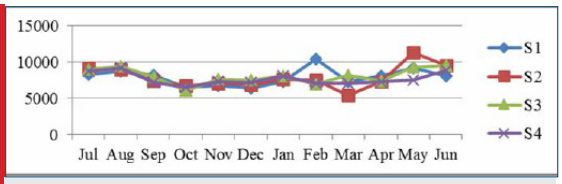

FIGURE 10: Physicochemical Parameters- Salinity (g/L) at sampling site (S1, S2, S3, S4), 2013-14.

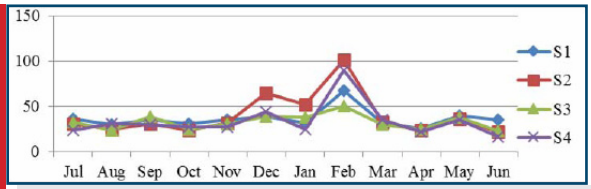

FIGURE 11: Physicochemical Parameters- Calsium (mg/L) at sampling site (S1, S2, S3, S4), 2013-14.

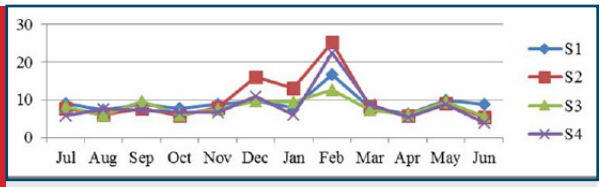

FIGURE 12: Physicochemical Parameters-CalciumHardness (mg/L) at sampling site (S1, S2, S3, S4), 2013-14.

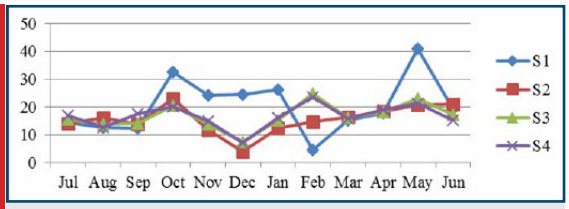

FIGURE 13: Physicochemical Parameters Mg. Hardness (mg/L) at sampling site (S1, S2, S3, S4),2013-14.

CONCLUSION

Lonar Crater Lake is a wet land of important biodiversity. It is extremely important for waterfowls, ducks, cranes, and many other migratory birds and microscopic organisms. The hydrological study revels deteriorating changes leading towards Eutrophication led to reduction of flora fauna and macrophytes and increase in pathogenic organisms. It is necessary to compile the available data together, so that the remedy for the conservation of the Crater will be possible only through comprehensive conservative measures which will be conceived during the project work. The lake brine supports typical microbial flora and fauna need to be investigated to access its value of wet-land to be recognized as Ramsar Site of India.

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